

Neosporidesmium himachalense* sp. nov. from India and *Neosporidesmina* gen. nov. to accommodate *N. micheliae

RAJNISH KUMAR VERMA^{1A*}, I.B. PRASHER², SUSHMA³,
AJAY KUMAR GAUTAM⁴, KUNHIRAMAN C. RAJESHKUMAR⁵,
ASHISH KUMAR⁶, RAFAEL F. CASTAÑEDA-RUIZ^{7B*}

¹ Department of Plant Pathology, Punjab Agricultural University,
Ludhiana, Punjab, 141004, India

² Department of Botany, Mycology and Plant Pathology Laboratory, Panjab University,
Chandigarh, 160014, India

³ Department of Biosciences, Chandigarh University Gharuan, Punjab, India

⁴ School of Agriculture, Abhilashi University, Mandi, Himachal Pradesh, 175028, India

⁵ National Fungal Culture Collection of India (NFCCI),

Biodiversity and Palaeobiology (Fungi) Gr. MACS, Agharkar Research Institute,
G.G. Agarkar Road, Pune, 411 004, Maharashtra, India

⁶ Department of Geography, Panjab University Chandigarh, 160014, India

⁷ Instituto de Investigaciones Fundamentales en Agricultura Tropical Alejandro de Humboldt
(INIFAT), OSDE, Grupo Agrícola,
Calle 1 Esq. 2, Santiago de Las Vegas, C. Habana, Cuba, C.P. 17200

*CORRESPONDENCE TO: ^A vermarajnish1985@gmail.com ^B rffcastanedaruiz@gmail.com

ABSTRACT—A new species, *Neosporidesmium himachalense*, collected from a decaying twig of an unidentified angiosperm in Mandi Himachal Pradesh, India, is described and illustrated. It is characterized by macronematous, laterally and terminally diverging conidiophores, terminal, doliiform, monoblastic conidiogenous cells, and obclavate 7–18-distoseptate, pale brown conidia. A new genus *Neosporidesmina* is proposed for *Neosporidesmium micheliae*, which has euseptate conidia.

KEY WORDS—anamorphic fungi, hyphomycetes, taxonomy

Introduction

Recent works on fungal biodiversity in India have prompted an increase in the mycobiota of the country with several new species and

new records (Adamčík & al. 2015; Buyck & al. 2017; Gautam & al. 2020; Sushma & al. 2020; Verma & al. 2019, 2020). During continuing surveys of microfungi associated with plant materials in Himachal Pradesh, India, a synnematus fungus was collected on an unidentified angiosperm decaying twig. Its conidiogenesis and conidial morphology placed this fungus in *Neosporidesmium* Mercado & J. Mena. Fifteen *Neosporidesmium* species have already been reported, from four countries: China (8 spp.), Cuba (1 sp.), India (4 spp.), and Vietnam (2 spp.). Distribution is depicted in the map (FIG. 1) constructed using the geographical coordinates mentioned in the protologues of these taxa. The original *Neosporidesmium* generic concept was expanded by Zhang & al. (2011), after the description of *N. micheliae*, which is characterized by having euseptate conidia. This species is clearly separated from the distoseptate *Neosporidesmium* generic concept, and we propose a new genus, *Neosporidesmina*.

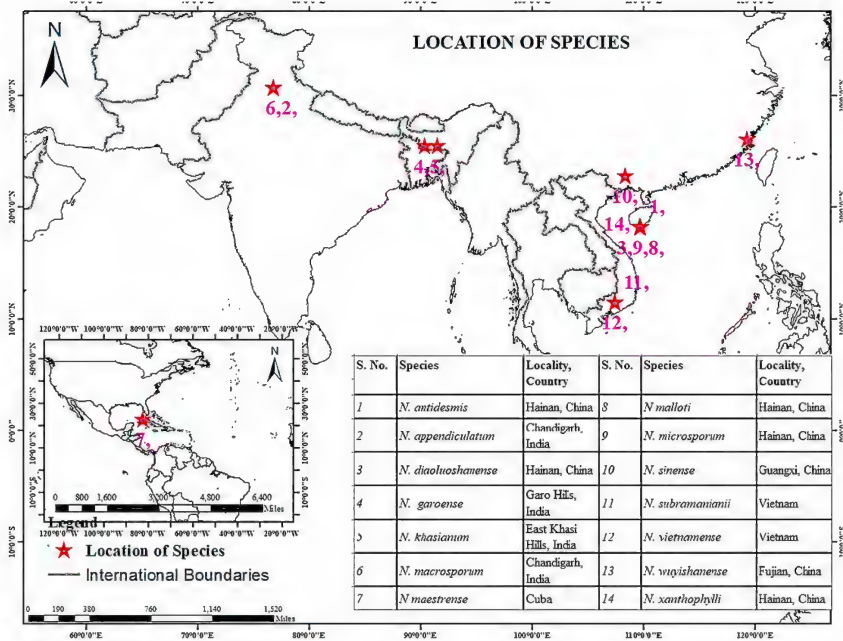


FIG. 1. Map showing the world distribution of *Neosporidesmium* spp.

Materials & methods

Decaying culms, leaves, twigs, bark, and dead wood were collected in separate zip lock plastic bags and brought to the laboratory. The specimens were mounted on glass slides in either 4% KOH, 0.01% cotton blue or lactophenol (Kirk & al. 2008). The specimens were studied microscopically under a matrix stereo trinocular microscope (VL-Z60) and a compound microscope (VRS-2f) for macroscopic and microscopic characters. All the measurements were taken assisted by Pro MED software and represented as the extreme values without statistical treatment. The specimens were deposited in herbarium of Panjab University, Chandigarh, India (PAN).

Repeated attempts to culture the fungus failed on various media (i.e., 2% agar broth, cornmeal agar (CMA), potato dextrose agar (PDA), oatmeal agar, malt extract agar (MEA), and solidified glucose peptone medium comprising: glucose 10 g/l, peptone 2 g/l, KH_2PO_4 1 g/l, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ 0.5 g/l, agar 20 g/l in 1000 ml H_2O with chips of host) with the addition of 50 µg/mL of two antibiotics (penicillin and streptomycin)—according to Choi & al. (1999) and Kirk & al. (2008). The distribution map was constructed by using ArcGIS software (Beyer 2004).

Taxonomy

Neosporidesmium himachalense Rajn.K. Verma, Prasher, Sushma,

A.K. Gautam, Rajeshk. & R.F. Castañeda, sp. nov.

Figs 2, 3

IF557994

Differs from *Neosporidesmium macrosporum* by its smaller conidia with fewer distosepta.

TYPE: India. Himachal Pradesh: Bilaspur (Jolplakhin), on dead and decaying twigs of angiosperm plant, 23 Nov 2015, R. K. Verma (Holotype, PAN 32815).

ETYMOLOGY: Latin, *himachalense*, refers to the Himachal, where the type was collected.

COLONIES on the natural substrate effuse, hairy, dark brown. Mycelium superficial, partly immersed in the substratum. CONIDIOMATA synnematal, erect, cylindrical, scattered, dark brown to black, tapering toward the apex, up to 2400 µm high and 90–150 µm wide at the base. CONIDIOPHORES macronematous, unbranched, septate, smooth, brown to dark brown, diverging laterally and terminally. CONIDIOGENOUS CELLS monoblastic, doliiiform, integrated, terminal, smooth, brown to dark brown, having 2–4 enteroblastic extensions ($11.5\text{--}21 \times 6.5\text{--}8.7$ µm). Conidial secession schizolytic. CONIDIA $72.5\text{--}151.5 \times 10.5\text{--}15.7$ µm, solitary, acrogenous, obclavate, 7–18-distoseptate, smooth, pale brown and paler at the apex.



FIG. 2. *Neosporidesmium himachalense* (holotype, PAN 32815): A. Synnemata attached to natural substratum; B. Synnemata; C. Conidia attached to conidiogenous cells; D, E. Conidia. Scale bars: A = 100 mm; B = 200 μ m; C–E = 20 μ m.



FIG. 3. *Neosporidesmium himachalense* (holotype, PAN 32815): Developing conidia and conidiogenous cells. Scale bars: A, B = 20 μm; C, D = 10 μm.

Neosporidesmina R.F. Castañeda, Rajn.K. Verma, Prasher, Sushma,
A.K. Gautam & Rajeshk., **gen. nov.**

IF 557995

Differs from *Sporidesmina* by its invariably euseptate conidia.

TYPE SPECIES: *Neosporidesmium micheliae* Y.D. Zhang & X.G. Zhang [= *Neosporidesmina micheliae* (Y.D. Zhang & X.G. Zhang) R.F. Castañeda & al.]

ETYMOLOGY: Latin, *Neo-*, meaning, new + Latin, *sporidesmina*, referring to the genus *Sporidesmina*.

COLONIES on the natural substrate effuse, hairy, dark brown. Mycelium superficial, partly immersed in the substratum. CONIDIOMATA synnematal, scattered, erect, cylindrical, dark brown to black. Mycelium superficial and immersed. CONIDIOPHORES macronematous, unbranched, diverging laterally and terminally, septate, smooth, brown to dark brown. CONIDIOGENOUS CELLS monoblastic, cuneiform, cylindrical or subulate, integrated, determinate, terminal, smooth, brown to dark brown. Conidial secession schizolytic. CONIDIA solitary, acrogenous, obclavate or cylindrical, euseptate, smooth, brown.

Neosporidesmina micheliae (Y.D. Zhang & X.G. Zhang) R.F. Castañeda,
Rajn.K. Verma, Prasher, Sushma, A.K. Gautam & Rajeshk., **comb. nov.**

IF 557996

≡ *Neosporidesmium micheliae* Y.D. Zhang & X.G. Zhang, Sydowia 63(1): 128 (2011).

Discussion

Neosporidesmium was erected by Mercado Sierra & Mena Portales (1988) for a single species, *N. maestrense*. The genus is characterized by effuse, dark brown to black, hairy colonies, unbranched conidiophores aggregating into erect, cylindrical, dark brown to black synnemata and integrated, terminal, monoblastic, lageniform or doliiform, determinate or percurrent extending conidiogenous cells. The conidia are solitary, obclavate or cylindrical, distoseptate, pale brown to brown, smooth. Subsequently, 14 other species were described: *N. antidesmatis*, *N. appendiculatum*, *N. diaoluoshanense*, *N. garoense*, *N. khasianum*, *N. macrosporum*, *N. malloti*, *N. micheliae*, *N. microsporum*, *N. sinense*, *N. subramanianii*, *N. vietnamense*, *N. wuyishanense*, and *N. xanthophylli* (Wu & Zhuang 2005; Ma & al. 2011; Zhang & al. 2011; Mel'nik & Braun 2013; Prasher & Verma 2015a,b; Li & al. 2015, 2017; Mel'nik & al. 2016, Pratibha & al. 2018; Index Fungorum 2020).

The criteria used for species delimitation are based primarily on conidiomata size, the enteroblastic extensions of conidiogenous cells, and

conidial morphology (Mercado Sierra & Mena Portales 1988, Wu & Zhuang 2005). Additionally, Prasher & Verma (2015b) described *N. appendiculatum* Prasher & Rajn.K. Verma as having conidial appendages. *Neosporidesmium macrosporum* Prasher & Rajn.K. Verma is comparable with *N. himachalense* but differs by its $\leq 1100 \mu\text{m}$ tall conidiomata and larger ($108\text{--}250 \times 12\text{--}16.5 \mu\text{m}$) 9–20-distoseptate conidia. *Neosporidesmium himachalense* also differs from other species in size of synnemata and number of conidial distosepta and sizes (TABLE 1).

Neosporidesmina is close to *Sporidesmina* Subram. & Bhat, typified by *S. malabarica*, which is characterized by erect, carbonaceous, compact, unbranched or mostly branched, divergent, synnematal conidiomata formed by indistinguishable, unbranched, tiny packed, septate, pale to dark

TABLE 1. Morphological comparison of accepted *Neosporidesmium* species.

SPECIES	SYNNEMATA [μm]	CONIDIAL SEPTA	CONIDIAL SIZE [μm]	REFERENCE
<i>N. antidesmatis</i>	950 $\times$ 30–50	11–15	48–75 $\times$ 7.5–9	Ma & al. 2011
<i>N. appendiculatum</i>	≤ 4700 long	9–15	82–148 $\times$ 17–19	Prasher & Verma 2015b
<i>N. diaoluoshanense</i>	605 $\times$ 40–60	8–11	105–135 $\times$ 10.5–13.5	Li & al. 2015
<i>N. garoense</i>	700–1620 $\times$ 50–65	11–13	75–100 $\times$ 8–11	Pratibha & al. 2018
<i>N. himachalense</i>	2400 $\times$ 90–150	7–18	72–151 $\times$ 10.5–15.7	This paper
<i>N. khasianum</i>	855–2750 $\times$ 50–60	10–12	103–135 $\times$ 10–18	Pratibha & al. 2018
<i>N. macrosporum</i>	1100 $\times$ 80–140	9–20	108–250 $\times$ 12–16.5	Prasher & Verma 2015a
<i>N. maestrense</i>	2500 $\times$ 60–250	8–12	55–100 $\times$ 15–19	Mercado Sierra & Mena Portales 1988
<i>N. malloti</i>	380 $\times$ 20–30	6–7	22.5–33.5 $\times$ 7–9	Ma & al. 2011
<i>N. microsporum</i>	1200 $\times$ 20–40	6–7	45–67 $\times$ 6–7	Wu & Zhuang 2005
<i>N. sinense</i>	1000 $\times$ 80–110	10–11	120–150 $\times$ 12–15	Wu & Zhuang 2005
<i>N. subramanianii</i>	600–1200 $\times$ 45–80	8–15	80–120 $\times$ 10–14	Mel'nik & al. 2016
<i>N. vietnamense</i>	500–1430 long	9–12	75–110 $\times$ 11–13.5	Mel'nik & Braun 2013
<i>N. wuyishanense</i>	$\leq 1290 \times$ 120	3–6	30–60 $\times$ 5–9	Li & al. 2017
<i>N. xanthophylli</i>	1000 $\times$ 40–55	6–10	33.5–51.5 $\times$ 12–14	Ma & al. 2011

brown conidiophores. The conidiogenous cells are monoblastic, cylindrical integrated, terminal, and producing solitary acrogenous elongated-fusiform brown conidia, that are 8–12-euseptate from the base toward near the end, but abruptly attenuate, sub-rostrate or subulate, hyaline, 1–2-distoseptate just below the apex (Subramanian & Bhat 1989). The two types of septa separate *Sporidesmina* from *Neosporidesmina*, which has only euseptate conidia.

Acknowledgments

We are indebted to Dr. De-Wei Li (The Connecticut Agricultural Experiment Station, USA) and Dr. Rosa María Arias Mota (Instituto Tecnológico Superior de Xalapa, Mexico) for serving as pre-submission reviewers and to Dr. Lorelei L. Norvell for final editorial review and Dr. Shaun Pennycook for nomenclatural review. The IBP is thankful to the Ministry of Environment and Forests, Government of India, for financial assistance (vide letter 14/26/2008–ERS/RE dt. 06.07.2010), and to UGC (SAP, DRSIII). The authors (RKV, IBP and Sushma) are thankful to Chairperson Department of Botany Panjab University for providing infrastructural and laboratory facilities. RFCR is grateful to Cuban Ministry of Agriculture for facilities.

Literature cited

- Adamčík S, Cai L, Chakraborty D, Chens XH, Cotter HVT, Dai DQ, Dai YC, Das K & al. 2015. Fungal biodiversity profiles 1–10. *Cryptogamie, Mycologie* 36: 121–166. <https://doi.org/10.7872/crym/v36.iss2.2015.121>
- Beyer HL. 2004. Hawth's analysis tools for ArcGIS. Available at <https://www.spatial ecology.com/htools>.
- Buyck B, Duhem B, Das K, Jayawardena RS, Niveiro N, Pereira OL, Prasher IB & al. 2017. Fungal diversity profiles 21–30. *Cryptogamie, Mycologie* 38: 101–146. <https://doi.org/10.7872/crym/v38.iss1.2017.101>
- Choi YW, Hyde KD, Ho WH. 1999. Single spore isolation of fungi. *Fungal Diversity* 3: 29–38.
- Gautam AK, Avasthi S, Prasher IB, Sushma, Verma RK. 2020. Diversity and distribution of cercosporoid fungi in Himachal Pradesh: an annotated checklist. *Studies in Fungi* 5: 17–49. <https://doi.org/10.5943/sif/5/1/3>
- Index Fungorum. 2020. <http://www.indexfungorum.org/Names/Names.asp> (Accessed 5 October 2020)
- Kirk PM, Cannon PF, Minter DW, Stalpers JA. 2008. *Dictionary of the fungi*, 10th edn. CAB International, Wallingford.
- Li XY, Liu SY, Zhang XG. 2015. A new species of *Neosporidesmium* from Hainan, China. *Mycotaxon* 130: 307–310. <https://doi.org/10.5248/130.307>
- Li HH, Zhang K, Xia JW, Yang CL, Wang JY, Zhang XG. 2017. *Neosporidesmium wuyishanense* sp. nov. from southern China, and a first Chinese record of *Morrisographium ulmi*. *Mycotaxon* 132: 547–552. <https://doi.org/10.5248/132.547>
- Ma J, Wang Y, Ma LG, Zhang YD, Castañeda-Ruiz RF, Zhang XG. 2011. Three new species of *Neosporidesmium* from Hainan, China. *Mycological Progress* 10: 157–162. <https://doi.org/10.1007/s11557-010-0685-2>

- Mel'nik VA, Braun U. 2013. *Atractilina alinae* sp. nov. and *Neosporidesmium vietnamense* sp. nov.—two new synnematos hyphomycetes from Vietnam. *Mycobiota* 3: 1–9. <https://doi.org/10.12664/mycobiota.2013.03.01>
- Mel'nik VA, Popov ES, Braun U. 2016. *Neosporidesmium subramanianii* sp. nov. from Vietnam. *Mycosphere* 7: 148–153. <https://doi.org/10.5943/mycosphere/7/2/6>
- Mercado Sierra A, Mena Portales J. 1988. Nuevos o raros hifomicetes de Cuba. *Acta Botanica Cuba* 59: 1–6.
- Prasher IB, Verma RK. 2015a. Some new and interesting hyphomycetes from North-Western Himalayas, India. *Nova Hedwigia* 100: 269–277. https://doi.org/10.1127/nova_hedwigia/2014/0215
- Prasher IB, Verma RK. 2015b. *Neosporidesmium appendiculatus* sp. nov. from North-Western India. *Mycological Progress* 14(87): [6 p.]. <https://dx.doi.org/10.1007/s11557-015-1112-5>
- Pratibha J, Mao AA, Prabhugaonkar A. 2018. Two novel species of *Neosporidesmium* from India. *Mycobiota* 8: 9–14. <https://doi.org/10.12664/mycobiota.2018.08.02>
- Subramanian CV, Bhat DJ. 1989 [“1987”]. Hyphomycetes from South India I. Some new taxa. *Kavaka* 15: 41–74.
- Sushma, Prasher IB, Verma RK. 2020. Some interesting hyphomycetous fungi from India. *Vegetos* 33: 74–82. <https://doi.org/10.1007/s42535-019-00083-8>
- Verma RK, Prasher IB, Sushma, Gautam AK. 2019. Two new additions to mycoflora (Hyphomycetes) of India. *Studies in Fungi* 4: 230–243. <https://doi.org/10.5943/sif/4/1/25>
- Verma RK, Gautam AK, Singh A, Avasthi S, Prasher IB, Nautiyal MC, Singh H. 2020. New record of rust disease caused by *Puccinia oxalidis* on *Oxalis latifolia* from India. *MycoAsia* 2020/01: [12.p].
- Wu WP, Zhuang WY. 2005. *Sporidesmium*, *Endophragmiella* and related genera from China. *Fungal Diversity Research Ser* 15: 351 p.
- Zhang YD, Ma WY, Ma LG, Castañeda-Ruíz RE, Zhang XG. 2011. New species of *Phaeodactylium* and *Neosporidesmium* from China. *Sydowia* 63: 125–130.